Alberta Acid Deposition Management Framework

Alberta Environment

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Alberta

Acid Deposition

Management Framework

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FOREWORD

Alberta Environment adopted the Acid Deposition Management Framework developed by the Clean Air Strategic Alliance for management of acid deposition effects in Alberta. The framework was described in the report: *Application of Critical, Target, and Monitoring Loads for Evaluation and Management of Acid Deposition (AENV, 1999)*. The framework prescribes a 5-year assessment cycle involving:

- Assessment of potential acid input (PAI) in each 1° latitude by 1° longitude grid cell in Alberta using the Regional Lagrangian Acid Deposition (RELAD) model.
- Evaluation of RELAD model-based PAI estimates using monitoring data.
- Revision of receptor sensitivity, as appropriate, based on new data.
- Comparison of PAI to receptor sensitivity. Management actions for acidifying emissions are required if monitoring, target, or critical loads are exceeded.
- Review, and possible revision, of the framework.

The Acid Deposition Assessment Group (ADAG) was appointed by Alberta Environment to guide the assessment and review the framework. ADAG consists of representatives from government, industry, and environmental organizations. Three documents were produced:

- an acid deposition assessment report
- a framework review report, and
- an acid deposition management framework document.

This 2008 document describes the Alberta Acid Deposition Management Framework that is based on the application of critical, target, and monitoring loads and replaces the previous 1999 report. A section describing the application of the management framework in the regional context was added.

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1.0 INTRODUCTION

National policy is in place to address acidifying emissions. In 1998, the Ministers of Environment of Canada and Provincial and Territories signed the Canada-Wide Acid Rain Strategy for Post 2000. For western Canada, the Strategy is designed to prevent an acidification problem from developing in areas already identified as clean. This is embodied in the nationally adopted principle of "keeping clean areas clean". This principle supports use of best available technology to minimize acidifying emissions in regions where acidification problems do not currently exist.

The Target Loading Subgroup (1996), the SO_2 Management Project Team (1997) and ultimately by the Clean Air Strategic Alliance (CASA) Board defined the Target Load as "the maximum level of acidic atmospheric deposition that affords long-term protection from adverse ecological consequences, and that is politically[1] and practically achievable" (Target Loading Subgroup, 1996). Subsequently, the Target Loading Subgroup developed a framework for managing acidifying emissions and acid deposition in Alberta (AENV, 1999). The framework is based on the application of critical and target loads.

This document replaces the report "Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition" (AENV, 1999) as the description of the Alberta Acid Deposition Management Framework.

1 In the context of the target load definition, "politically" encompasses social, economic, and technological considerations.

2.0 ACID DEPOSITION MANAGEMENT FRAMEWORK

The management framework is based upon four defined levels of acid deposition: pre-industrial deposition (background), the current level of deposition, the target load, and the critical load. These four levels define three management zones (Figure 1). The critical load is a numerical expression of the highest level of deposition that will not lead to long-term, harmful changes to a receptor.

Continuous improvements are employed in the lowest management zone, defined by background deposition (pre-industrial deposition) at the bottom and current deposition levels at the top. Current emissions are not deemed as being simply acceptable, but rather methods of reducing current levels of emissions, and hence deposition, should constantly be sought and pursued.

Management of new and expanding emission sources and emission minimization are conducted in the second management zone that is bounded by current deposition levels at the bottom and the target load at the top. The primary management tools applied in this zone include voluntary measures employed by industry, application of best available technology economically achievable (BATEA) for emissions minimization, and regulatory operating approval conditions. The processes directed towards continuous improvement (as described in the lower zone) are also to be applied in this zone, such that a constant effort to maximize efficiency and minimize emissions and acid deposition is made.

The monitoring load divides the emissions minimization zone into two sub-zones. Emissions management opportunities and actions do not differ between the sub-zones; however, in the upper sub-zone, additional activities related to monitoring and the study of receptor sensitivity are to be conducted. If the monitoring load is exceeded, Alberta Environment (AENV) will make an announcement that such monitoring and/or receptor studies are being implemented, invite stakeholders to participate, and report to stakeholders and the public on the results. Reporting may occur through the CASA.

Above the emissions minimization management zone is the emissions reduction management zone that is set by the target load. A target load is defined as a level of deposition that considers the critical load, and that is practically and politically achievable (Target Loading Subgroup, 1996). Entry into this zone results in implementation of more restrictive management processes. Once deposition in a grid cell exceeds the target load, a strategy to reduce deposition to below the target load is to be developed. Used in this manner, the target load becomes an environmental objective as defined in Section 14.1 of the Environmental Protection and Enhancement Act (EPEA) for the management of acidifying emissions and acid deposition.

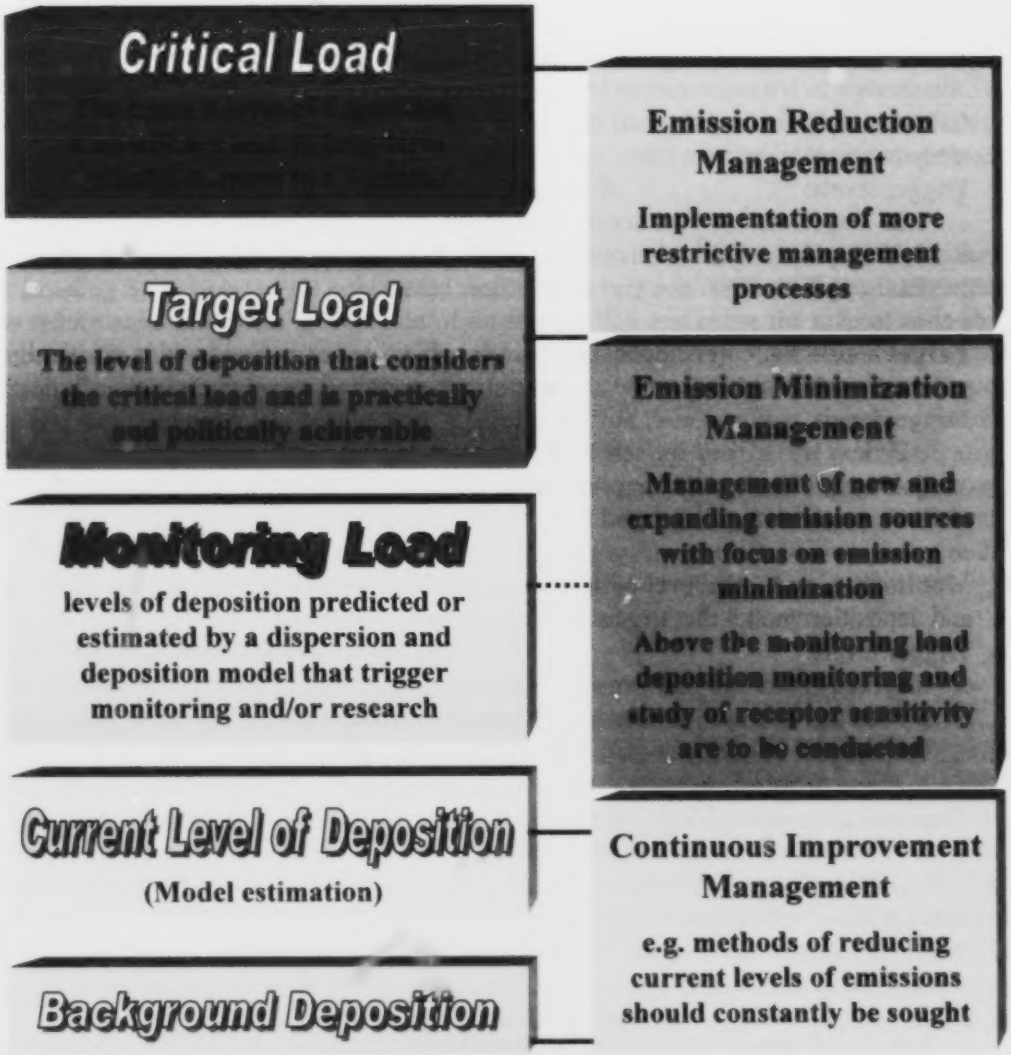

Figure 1 Acid Deposition Management Framework

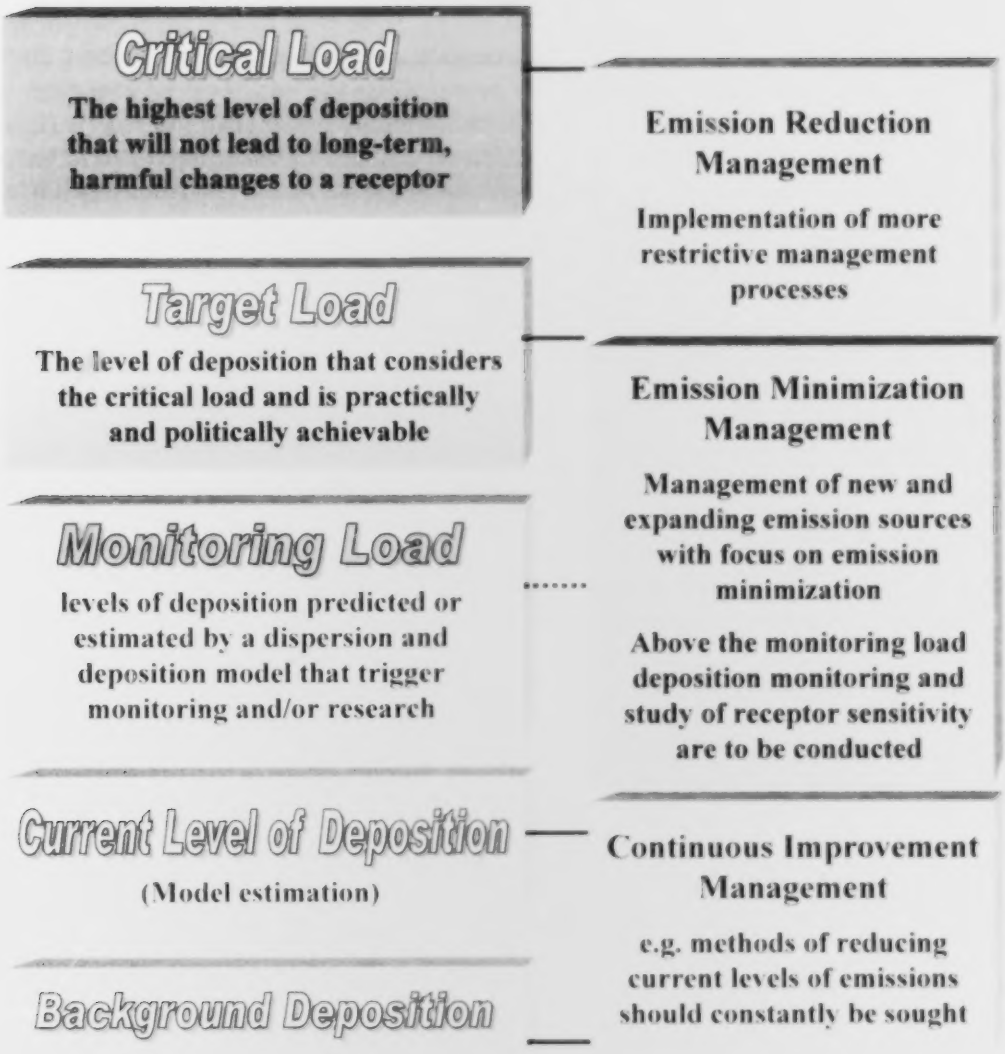

Figure 1 Acid Deposition Management Framework

3.0 PROVINCIAL ACID DEPOSITION MANAGEMENT

The critical, target and monitoring load for provincial scale applications are set to be:

- **Critical load** - the highest load that will not lead to long-term, harmful changes to a receptor.
  Trigger levels:
  - 0.25 keq H^+ ha^{-1} yr^{-1} for sensitive grid cells
  - 0.50 keq H^+ ha^{-1} yr^{-1} for moderately grid cells
  - 1.00 keq H^+ ha^{-1} yr^{-1} for grid cells of low sensitivity

- **Target load** - the level of deposition that consider the critical load and is practically and politically achievable.
  Trigger levels:
  - 0.22 keq H^+ ha^{-1} yr^{-1} for sensitive grid cells
  - 0.45 keq H^+ ha^{-1} yr^{-1} for moderately sensitive grid cells
  - 0.90 keq H^+ ha^{-1} yr^{-1} for grid cells of low sensitivity

- **Monitoring load** – the level of deposition predicted or estimated by a dispersion model and deposition model that trigger monitoring and/or research.
  Trigger levels:
  - 0.17 keq H^+ ha^{-1} yr^{-1} for sensitive grid cells
  - 0.35 keq H^+ ha^{-1} yr^{-1} for moderately sensitive grid cells
  - 0.70 keq H^+ ha^{-1} yr^{-1} for grid cells of low sensitivity

The Regional Lagrangian Model of Acid Deposition (RELAD) is used for assessing the current level of deposition. A detailed description of the RELAD model has been provided in Cheng *et al.* (1995), Cheng and Angle (1996) and McDonald *et al.* (1996). When applied to the whole province of Alberta the acid deposition management framework becomes the Provincial Acid Deposition Management Framework.

3.1 Level of Protection and Management Unit

A 95% level of protection is acceptable to stakeholders and members of the public (government, industry, non-governmental organizations) that are represented through Alberta's CASA. For application in Alberta, the 95% level of protection is interpreted as follows. A grid is superimposed upon the combined receptor sensitivity map. The grids are defined by the intersection of whole degrees of latitude and longitude. Grid cells equal 1° latitude x 1° longitude (approximately 111 km x 60 km). If 5% or more of the area contained within a grid cell is rated as sensitive to acid deposition, then the entire grid cell is classified as sensitive. If less than 5% of the area is sensitive, but the total of sensitive and moderately sensitive areas equals or exceeds 5% of the grid cell area, the grid cell is classified as moderately sensitive. All remaining grid cells are classified as low sensitivity. The grid cell sensitivity assignments are used as the basis for application of critical, target and monitoring loads.

3.2 Alberta Sensitivity Map

The primary receptors of acid deposition are soil and aquatic systems. For this reason, most of the efforts in deriving critical loads for acid deposition have focussed on soil systems and water bodies. Soils may be of mineral or organic origin. Aquatic systems located in watersheds composed of mainly mineral soils will differ substantially from those located in watersheds containing mostly organic soils. Wetlands (marshes, bogs, fens) may be intermediate between organic soil and aquatic systems, having properties of both.

Lake sensitivity data are not sufficient for deriving a provincial critical load map in Alberta. The Target Loading Subgroup (1999) considered the close correlation of the ability of subsurface soils to reduce acid input with the location of sensitive lakes, and chose the map of soils ability to reduce acid input as a surrogate for the description of areas containing lakes sensitivity to acid deposition. Combining the receptor sensitivity data in this way represents the best integration of aquatic and soil sensitivity knowledge that is possible at that time, and was, therefore, used as the database for the application of the critical, target and monitoring loads. Data from Holowaychuk and Fessenden (1987) for soil sensitivity to acid input and potential of soil and geology to reduce acidity of incoming acid deposition were used to derive the original sensitivity map. The receptor sensitivity map that is currently used for acid deposition assessment is provided in Figure 2.

3.2.1 Exceedance of the Monitoring Load

The monitoring loads are established below the target loads, at 0.17 keq H^+ ha^{-1} yr^{-1}, 0.35 keq H^+ ha^{-1} yr^{-1}, and 0.70 keq H^+ ha^{-1} yr^{-1}, for sensitive, moderately sensitive and low sensitivity cells, respectively. If, as the result of a 5-year evaluation, deposition is predicted to occur in a grid cell that is in excess of the assigned monitoring load, AENV will take the following actions:

(i) as part of the assessment report, a notice announcing the implementation of monitoring and receptor sensitivity studies in the affected cell(s) will be made.

(ii) to the extent possible using the RELAD model, grid cells which contain sources of acidifying emissions that contribute to deposition above the monitoring load in the grid cell of concern will be identified.

(iii) representatives from organizations which are the major emission sources that contribute to acid deposition in the affected cell(s) will be brought together to discuss the best approach to monitoring and research studies, and to discuss the funding of these studies. An equally important purpose for these stakeholder discussions is to ensure that all parties understand the process used to manage acid deposition, and their responsibilities in contributing to the management of emissions and deposition.

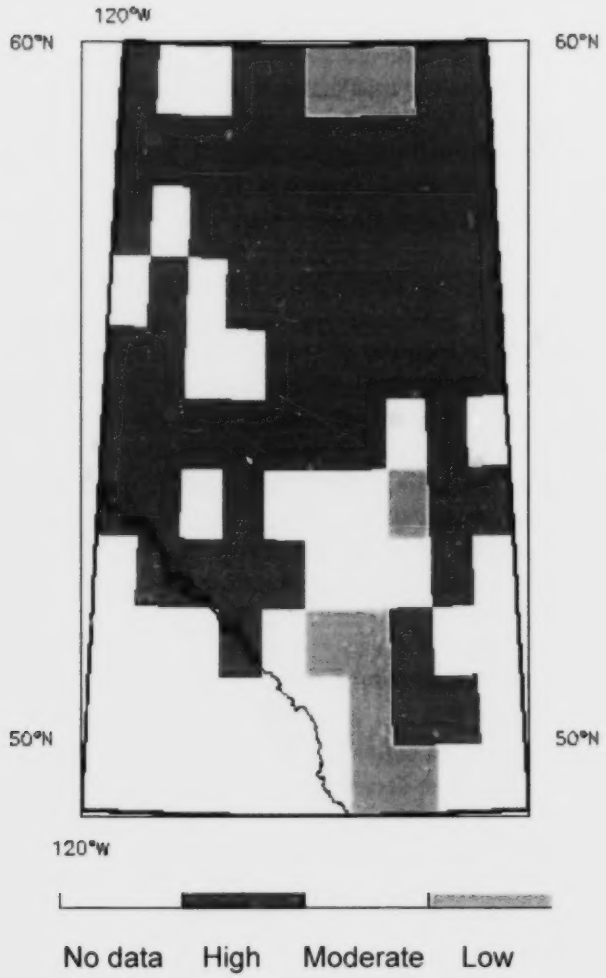

Figure 2 Receptor sensitivity in Alberta

(iv) stakeholders representing other interests (e.g., non-governmental organizations, residents in the affected grid cell(s)) will be invited to participate in the design and implementation of monitoring and/or research projects for the cell(s).

(v) AENV will ensure that the participation of stakeholders is meaningful, and that consultation is not used to delay action. AENV remains the authority for ensuring that actions necessary for the protection of the environment are taken, including actions related to monitoring and research.

The intent of the monitoring load is to allow time to collect data regarding trends in emissions and deposition and the sensitivity of the recipient system, before the need to take emission management actions arises.

3.2.2 Exceedance of the Target Load

Given the activities that occur following an exceedance of the monitoring load, exceedance of a target load coincident with an absence of monitoring and research data should be a rare occurrence. However, with increasing development and urbanization, deposition in excess of a target load within a grid cell or cells is possible.

Used in the manner described in the remainder of this section, the target load becomes the environmental objective, a regulatory instrument, as defined in Section 14 of EPEA. If applied other than as described here, the target load is not to be considered as a regulatory instrument.

3.2.2.1 Development of an Acid Deposition Management Plan

As structured, the management framework (Figure 1) maximizes the potential for management on the basis of measurement (monitoring and receptor measurement), and minimizes the reliance on model prediction. Thus, should emission reductions be required, stakeholders should already be aware of, and participating in, activities related to monitoring of deposition and examination of receptor sensitivity in grid cells that have exceeded the monitoring load in previous assessments. For the most part, it is the same group of stakeholders that will be given the task of deriving a management plan to reduce emissions to below the target load. Thus, there should be little delay in responding to an exceedance of the target load.

For each cell that is predicted (model result), or observed (monitoring result) to exceed the assigned target load, an Acid Deposition Management Zone (ADMZ) will be established. Establishment of this zone will be the responsibility of AENV and the Energy and Utilities Board. The ADMZ will include the exceedance cell and all grid cells which substantially contribute to deposition in the exceedance cell. There may be some cells that do not include acidifying emissions that contribute to the exceedance, but are located between cells that do, and that if development were to occur within them, would be a contributor. These cells would be included in the ADMZ. The boundaries of the ADMZ would be described within the 5-year assessment report. A general public notice, in an appropriate forum(s), will be made to ensure that stakeholders affected by, and interested in, the establishment of the ADMZ are notified. The notice will be provided directly to all facilities with EPEA and/or Energy and Utilities Board (EUB) approvals for SO_2 and NO_x emissions within the ADMZ. Additionally, industrial associations, environmental advocacy groups, municipalities, and other government agencies will receive copies of the announcement. This process is to ensure that proponents of facilities (small and large), and potential investors in activities in the ADMZ (e.g. acquisition of sour gas leases, investment in small facilities) are aware of potential future management actions that could affect the value of their investment(s)[2].

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[2] Should more than one cell be identified as being in exceedance of its assigned target load, this procedure will be implemented for each exceedance. Each exceedance will be addressed; depending upon the location of the exceeding cells, there may be one, or more than one, stakeholder group formed to derive appropriate emissions management strategy(ies).

Stakeholders brought together to develop the management plan that will result in emission reductions and decreases in acid deposition to below the target load(s) will have a 2-year period to derive an emissions-reduction plan. Implementation should be essentially complete to achieve measurable reductions within 3 years. AENV will participate in, and should it become necessary, facilitate this process. At the end of this period, AENV will receive from stakeholders a written description of the ADMZ management plan. This plan will include:

(i) a program to evaluate overall emissions reductions necessary to reduce acid deposition to less than the target load and to establish related long-term emissions management objectives for the ADMZ. An evaluation of required emission reductions and derivation of an emissions reduction schedule are to be developed. The goal will be based upon achieving measurable reductions within 5 years, and achieving all necessary reductions to reduce deposition to no greater than the target load in the exceedance cell within 10 years (taking into account the economic and social impact of mandated emission reductions).

(ii) a process to allocate emission reduction targets to regulated emission sources in the ADMZ and to modify facility approvals (EPEA, EUB) accordingly.

(iii) a process to facilitate approval of new emission sources in the ADMZ in a manner that will not result in increased deposition in the exceeding grid cell, and that will meet overall emission reduction targets for the ADMZ.

(iv) emission inventory and acid deposition monitoring programs to verify progress of the management plan. The program will include processes for adjusting emission reduction targets based on actual performance of the management system.

(v) measures to reduce urban emissions where these emissions contribute substantially to the exceedance cell(s).

In deriving the ADMZ management plan, all options are open for consideration by stakeholders, and include, but are not limited to, installation of pollution abatement equipment, emissions trading, and mandated implementation of offsets. Offsets may occur among industries, or between industries and urban residents.

Resolution by stakeholders is the preferred solution. However, in the event that stakeholders are unable to derive a management plan, or if emission reductions under such a plan are not achieved, AENV in consultation with other Alberta regulatory bodies will develop and impose a management plan as described above.

It is expected that representatives from municipalities within an ADMZ will also fully participate in the stakeholder consultation process, and will work collaboratively with other participating stakeholders to minimize and reduce emissions from within each municipality in the ADMZ.

3.2.2.2 Approval of Facilities within the Acid Deposition Management Zone

If either measured or modelled (in the absence of measured) deposition exceeds the target load, and in the absence of an acid deposition management plan, a new licensed source within the ADMZ which will contribute more than 10 tonnes per day (t/d) of SO_2 equivalents (sum of SO_2 + NO_x, expressed as SO_2 equivalents), will be required to offset these emissions in one of two ways:

(i) an offset equivalent to the emissions from the new source may be garnered from other emission sources within the grid cell containing the new source. The offset is to be determined on the basis of SO_2 equivalents, thus, offsets may include SO_2, NO_x, or some combination thereof.

(ii) an offset which will achieve deposition neutrality (no increase in deposition) in the affected cell may be garnered from emission sources from other grid cells within the ADMZ. The proponent of the new facility must clearly demonstrate that these offsets satisfy the requirement for deposition neutrality in the exceedance cell.

These options provide flexibility for new development in the event that a target load is exceeded. The first option represents a relatively easy way to achieve offsets: a one-to-one offset can be obtained from within the cell containing the new development. No modelling or other analysis is required. The second option provides the opportunity for a less than one-to-one offset, however, the proponent must demonstrate through the use of dispersion and deposition models that the offsets will not lead to increased deposition in the exceedance cell following development and commissioning of the new facility.

Development of facilities within an ADMZ that emit less than 10 tonnes of SO_2 equivalents per day (t SO_2 eq. day^{-1}) will also be affected by the target load exceedance. The EUB is responsible for regulating, including the approval of, small energy resource facilities that emit acidifying emissions (primarily SO_2). It is recognized that without guidelines regarding these sources, a proliferation of small sources within a grid cell contained in the ADMZ could result in emissions at or above 10 t SO_2 eq. day^{-1}, the level requiring offsets. Thus, at the time of establishment of an ADMZ, the EUB will begin tracking small developments in each grid cell within the ADMZ. Should the cumulative emissions from these small facilities achieve or exceed 10 t SO_2 eq. day^{-1}, the operators of these small facilities will be required to obtain and implement the offsets as described above. These offsets may be achieved by either of the two options described above. The offsets must be sufficient to achieve deposition neutrality, defined in this instance as the level of deposition at the time that the grid cell was determined to be in exceedance of its assigned target load.

In order to ensure that the operators of small (less than 10 t SO_2 eq. day^{-1}) facilities are aware that emission reductions, or emission offsets, may be required of them in the future, an approval for a facility in an ADMZ (the zone contributing to a target load exceedance in one or more grid cells) will contain an approval condition specifying that emission reductions may be required at some future date. These reductions may be stipulated in a revised approval issued to the operator.

It is important to reiterate that the emission offsets, approval conditions, and revised approvals are tools that will be utilized only in the instance of a target load exceedance in one or more grid cells. Concurrent with these activities will be the derivation of a management plan by stakeholders within the ADMZ that will, once implemented, reduce deposition in the exceedance cell to no more than the target load. Operators of new facilities will have the opportunity to participate in the development of the plan, in collaboration with operators of existing facilities and other stakeholders.

3.2.3 Exceedance of the Critical Load

As structured and applied, the management framework should all but eliminate the possibility that the critical load will be exceeded within any grid cell. Measurement of deposition and receptor sensitivity based upon the use of the monitoring load, and management of emissions and deposition based upon the use of the target load as the environmental objective, should ensure that emission reductions are implemented prior to acid deposition increasing to above the critical load for any grid cell.

In the event that a critical load exceedance is predicted or observed, an emission reduction management plan shall be developed by the stakeholders and will be implemented on an accelerated schedule. It is important to note, however, that even in the event of a critical load exceedance, environmental damage is not necessarily imminent. Damage will occur should deposition above the critical load be sustained over many years. Thus, management strategies to reduce emissions and deposition to below the critical (and target) load will preserve environmental integrity and sustainability.

3.3 Five –Year Acid Deposition Assessment

The evaluation of acid emissions and subsequent deposition relative to receptor sensitivity will be repeated on a regular basis in order for critical, target and monitoring loads to be effective management tools. AENV will conduct these assessments to answer questions such as:

- what is the current situation regarding acid deposition?
- are large areas being put at risk due to deposition of acidifying substances?
- are there changes in acid deposition patterns over the long-term that indicate that harmful effects may occur in some areas in the foreseeable future?
- are activities in Alberta negatively impacting the environment in neighbouring jurisdictions?

Assessments are to be completed at 5-year intervals. Each 5-year assessment will include the following sections in the assessment.

3.3.1 An Estimation of PAI in Each Grid Cell in Alberta.

Based upon the most recent available emissions inventory, base cation deposition data, and meteorological data, an estimation of deposition in each grid cell will be made using the RELAD model. The model will be used as described in this document to predict deposition in 1° latitude x 1° longitude grid cells. The grid cells are defined by the intersection of whole degrees of longitude and latitude, where the intersection occurs in the centre of the cell.

3.3.2 Validation of the Model Predictions.

Any ambient and/or deposition monitoring data that has become available since the previous assessment will be used to validate predictions by the deposition model. Actual deposition data should be available from grid cells that exceeded the monitoring load. In these cases, a detailed evaluation of monitoring data from these cells should be conducted.

3.3.3 Review and Revision of the Receptor Sensitivity Database.

New data regarding receptor sensitivity will be incorporated into the database, and receptor sensitivity in the grid cells will be updated as required to reflect the new data. Receptor sensitivity data may come from a number of sources, including Environmental Impact Assessments for new facilities, environmental (ecological, biological) effects monitoring programs, research projects, and sampling surveys. Cells, which have been predicted to receive acid deposition above the monitoring load, should have been evaluated for receptor sensitivity during the period since the previous assessment. Data obtained between assessments may lead to a revision of the critical load (and therefore the target and/or monitoring load) for individual grid cells, should the data indicate that receptor sensitivity is different from that assigned in the previous assessment.

3.3.4 Compare Deposition to Receptor Sensitivity.

Comparison of estimated (and if available, measured) PAI to receptor sensitivity in each grid cell is most easily done by calculating deposition as the proportion of the critical, target, and monitoring loads for each grid cell.

3.3.5 Review of Science Gaps and Recommendations

As an implementation of the continuous improvement principle, status of the science gaps identified and recommendations put forth in the previous assessment should be reviewed. If deemed appropriate or necessary, new recommendations may be put forth to fill the gaps in science or for improvement of the assessment.

3.3.6 Public and Stakeholder Input and Generation of a Report Describing the Results of the Assessment.

Public and stakeholder input will be included as part of each assessment. Public and stakeholder involvement may continue to be facilitated by the CASA. The results of each 5-year assessment will be presented in a report that will be available to stakeholders and to the public.

This Provincial Acid Deposition Management Framework is built upon the use of the RELAD model. At present, the RELAD model is the standard for estimating acid deposition on a provincial scale. It is recognized that models such as RELAD are continuously improving, and that new models may become available in the future. If RELAD is substantially changed, if the basis for application of the RELAD results is changed (i.e. application of the results to grid cells of a size other than 1° latitude x 1° longitude), or if a different model is used for the estimation of acid deposition, the management system described in this document will be re-evaluated to ensure that it is compatible with the revised or alternate model. This re-evaluation will be conducted as part of the 5-year assessment, and will include stakeholder consultation.

In addition to an adjustment of the framework to include a substantially altered, or new, deposition model, the framework itself will be evaluated. Should modification of the framework be appropriate, and lead to more effective management of acid deposition, adjustments will be made. Public involvement will be included, and the refined framework will be documented within the 5-year acid deposition assessment report.

Should the assessment indicate that deposition in one or more grid cells exceeds one of the assigned loads for the cell(s), certain actions are to be taken. These actions will be outlined in the assessment report, and will be initiated by Alberta Environment. Stakeholders will be expected to participate in the activities that are undertaken to address the exceedance. The nature of the activities will be dependent upon the nature of the exceedance.

4.0 REGIONAL APPLICATIONS

It is recognized that regional acid deposition frameworks may be required and are an appropriate and desirable approach for managing emissions and/or acidification effects of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) for a region or an airshed. Regional frameworks must follow the principles and approaches in the Provincial Framework and be guided by the following goal:

Goal: Management of acid deposition to prevent adverse effects on ecosystems, plants and animals in the regional management area.

This section outlines some of the elements and considerations that must be part of any regional acid deposition management framework.

4.1 Triggers for Regional Frameworks

The Provincial Acid Deposition Management Framework sets out the minimum criteria for acidifying emissions. While necessary, the provincial framework may not be sufficient to adequately protect valued local ecosystems. In such situations, regional stakeholders may agree to, or the Government of Alberta may require, the development of a regional acid deposition management framework.

Planning and implementation of a Regional Acid Deposition Management Framework will either be triggered by exceedance of action levels as outlined in section 4.4 or be initiated by regional stakeholders to proactively address potential acidification issues and/or concerns. Some of the information sources and factors that may result in the initiation of a Regional Acid Deposition Management Framework include:

- Information from Environmental Impact Assessments (EIAs),
- Regional monitoring data,
- Regional acid deposition concerns,
- Sensitive and valued local and/or regional ecosystems, and
- Other available studies and information sources.

4.2 Modelling Tools and Protocol

In order to realistically capture the detailed deposition characteristics close the emission sources, for regional modelling of acid deposition, CALPUFF, or any other deposition model recommended by Alberta Environment, shall be used. Specific protocols are outlined in the Air Quality Modelling Guideline (Alberta Environment, March 2003).

To ensure that planned development in or around a region does not result in acid deposition issues, and also to guide management of acidifying emissions, a project proponent should be required to complete regional acid deposition modelling if:

- the proponent's combined emissions of SO_2, NO_x, and NH_3 are greater than 0.175 t/d of H^+ equivalent,
- there is evidence that regional soil and surface water is more sensitive to acidification than is estimated in the provincial framework, or
- there is existing deposition and/or acidification impact monitoring that indicates a potential concern if acid deposition increases.

Acid deposition modelling would not normally be required if:

- the proponent's emissions of SO_2, NO_x, and NH_3 of SO_2 equivalent are less than 5% of the baseline (existing and approved facilities) emissions and less than 0.175 t/d of H^+ equivalent,
- the proponent's emissions have been included in a recent EIA study with acid deposition estimates, or
- if there is monitoring and ecosystem sensitivity data to indicate that the proposed emissions will not trigger any management action criteria.

Notwithstanding the foregoing, AENV's Director of Environmental Assessment or Alberta Environment Approval Director may require a proponent of a project to conduct one or more air quality and/or deposition modelling exercises if there is some overriding concern that must be addressed. Figure 3 illustrates the steps to follow to determine if acid deposition modelling is required for the proposed project.

4.2.1 Application of Background

When EIAs or regional air quality impact assessments are prepared, proponents are required to incorporate regional background values to the model estimation of acid deposition within the study area. Regional background includes the global background and transport from the upwind boundary. One of the following two methods is to be used to select the regional background values:

- Monitoring: Existing monitoring data at remote sites within and outside of the EIA study. Since the values from within the study area already include all existing acidifying emissions within the region as well as the background values, the regional-based acid deposition levels are the study area values minus the remote site levels.
- Modelling: Provincial scale modelling is conducted with emissions in the regional study area excluded from the model domain. Global background values are added to the provincial modelling results. The global background values are obtained from monitoring data in a remote area upwind of the provincial model domain that is not influenced by industrial emissions.

4.3 Considerations for Regional Frameworks

The following factors shall be taken into consideration when setting up and implementing a regional management framework.

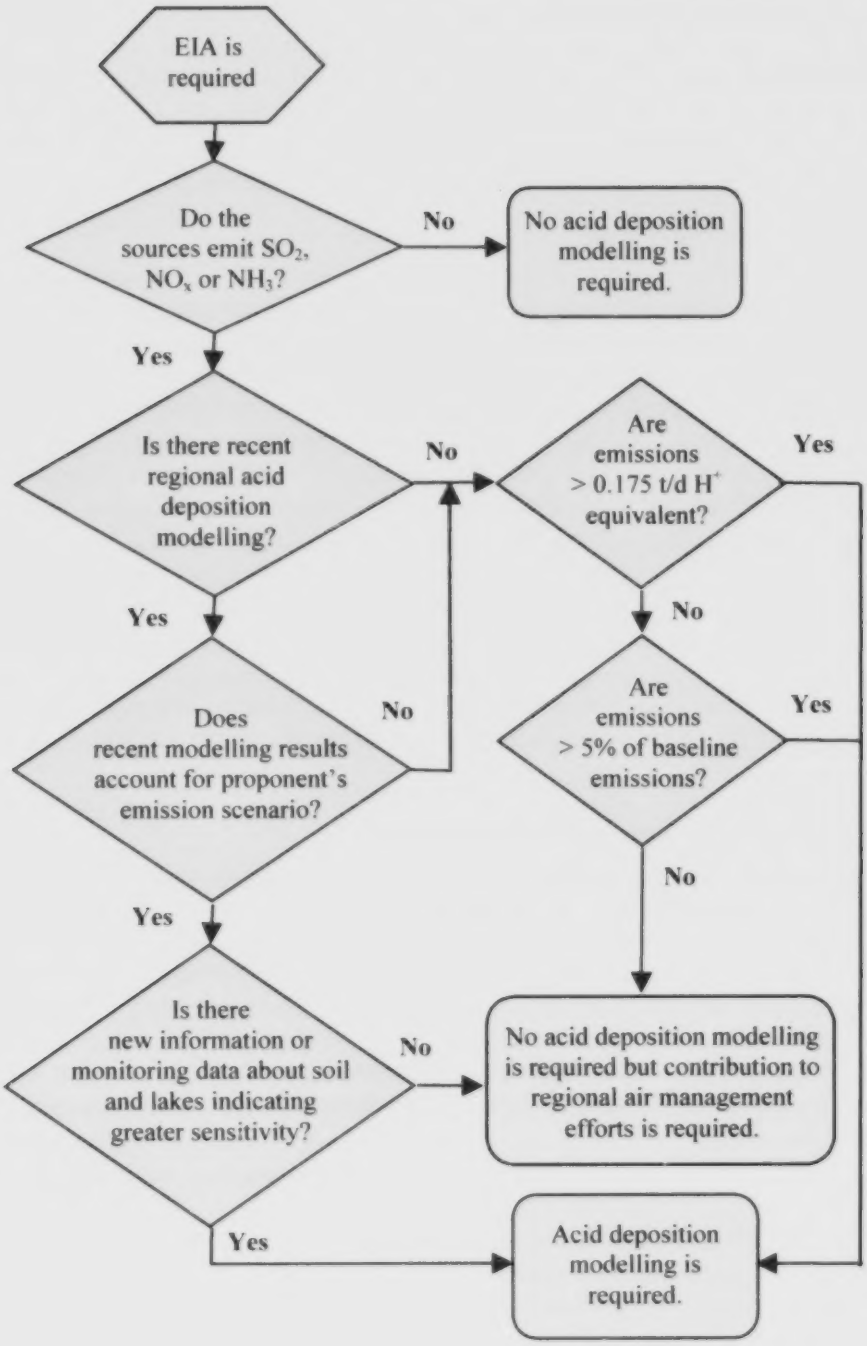

Figure 3 **Procedural steps to determine if acid deposition modelling is required for the proposed project**

Management Area

The 'management area' is the area to which the regional management framework will be applied. The extent of this area shall be determined by the stakeholders and should include all emission sources that will contribute substantially to acid deposition in the region.

4.3.1 Level of Protection

The level of protection defines the percentage of the 'management area' and selected ecosystem component(s) (e.g., soils, lakes) that would be protected at the selected critical load. The Provincial Acid Deposition Management Framework uses a 95% level of protection for each 1° latitude x 1° longitude grid cell. The default level of protection for regional management shall be the same as the provincial framework. If significant regional resources are at risk, a regional framework may establish spatial or deposition criteria that are more stringent than a 95% level of protection for a 1° latitude x 1° longitude grid cell. Under no circumstance can the regional level of protection be less stringent than the provincial level.

The following factors should be taken into consideration in determining whether an alternate to the provincial approach is warranted:

- The economic and/or ecological significance of the resources at risk.
- The level, duration and significance of damage that is anticipated.

4.4 Regional Management Frameworks

Consistent the principles and intent of the Provincial Acid Deposition Management Framework, regional frameworks should establish equivalent action levels. These management actions will be triggered if specific levels of potential acid input (PAI) or established impact measures are exceeded.

The following sections outline the key components of the provincial acid deposition framework including the action levels, action triggers, and management tools and how they would apply in a regional framework.

4.4.1 Action Levels

Action levels represent a continuum of analysis and management activities based on monitored and modelled PAI. Regions can establish their own action levels and triggers, but these should reflect the intent of the four action levels as outlined below.

4.4.2 Below the Monitoring Load

This is a level at which acid deposition for the region is currently below the monitoring load. (Note: in a regional framework this acid deposition level trigger could be replaced or augmented

with an early warning physical or biological change trigger that is monitored at strategic locations in the region.) The primary goal at this level is to continue current monitoring. No additional monitoring or management activities are required.

- Ongoing monitoring continues.
- Any existing Keeping Clean Areas Clean (KCAC) and Continuous Improvement (CI) activities continue to apply.

4.4.3 Monitoring Load

When this type of action level has been triggered additional monitoring and possibly impact analysis should be undertaken to determine such things as the source(s) of emissions, trends in PAI, and ecosystem responses. The focus is to ensure that adequate data collection to assess and understand the extent and potential impacts of PAI. In addition, cost effective action should be taken to reduce acidifying emissions.

If PAI is currently at or above a monitoring load equivalent trigger, AENV may take a more active role in the application of the Regional framework to ensure:

- the adequacy of existing monitoring in the region
- that there is a good understanding of the sensitivity of receptors in the region.
- all stakeholders are aware of the situation .
- opportunities for KCAC and CI are identified and encouraged.

4.4.4 Target Load

When the equivalent of a target load has been exceeded in a Regional framework, there should be a management plan to address the issue or a process for developing such a plan. The plan or process must be designed to reduce acid deposition, appropriate to predicted PAI and regional needs. If a plan must be developed, this should be done within 2 years. Implementation will begin immediately upon acceptance of the plan, and implementation should be essentially complete within 3 years. AENV will participate in, and should it become necessary, facilitate the process of plan development and/or implementation. If stakeholders do not agree to, and implement, the management plan within the required time frame, AENV may impose a plan.

When development of the plan is required it should include the following:

- AENV or the affected stakeholders, as appropriate, leads identification of key stakeholders, both from the emissions sources and receptor communities.
- It is suggested the consensus model be used for plan development.
- The group responsible for the development and implementation of the Regional framework would normally lead development of the plan. However, AENV may choose to lead the development plan or use another group.
- Existing data and analysis is gathered to inform the management planning process. Additional analysis of transboundary contributions, sources, trends, growth, forecasts, reductions from other programs, existing and required monitoring is performed, if necessary.

- Develop and implement a management plan.
- Develop and implement a public communication consultation strategy.

4.4.5 Critical Load

If critical loads or equivalent are exceeded, the Regional framework must have a plan or process for implementation of actions within 2 years which is designed to reduce acid deposition. When the critical load or equivalent has been triggered:

- AENV may take the lead depending on the nature of the Regional framework and an assessment of the ability of regional stakeholders to expeditiously address the issue.
- All key stakeholders, including airshed zones, must be identified and consulted, from both emissions sources and receptor communities.
- All available information must be assembled including: transboundary contribution, sources, trends, growth, forecasts, and reductions from other existing programs. Gaps in the information needed for management planning must be filled.
- AENV will ensure that monitoring is adequate.
- A comprehensive management plan must be developed and/or implemented.
- National and provincial reporting requirements must be met.
- There must be public consultation and communication of the exceedance and the actions to be taken.

5.0 POTENTIAL DIFFERENCES BETWEEN THE PROVINCIAL AND REGIONAL ACID DEPOSITION FRAMEWORKS

The Provincial Acid Deposition Management Framework is intended to identify potential acidification issues at an early stage and establishes a tiered approach to addressing these issues depending on their magnitude. The Framework is based on a number of conservative and general assumptions and also on large scale modeling and sensitivity mapping. On a regional or airshed scale, more refined monitoring and modeling is possible which can result in some significant differences between the provincial and regional frameworks. These potential differences are summarized in Table 1. It should be reiterated that a level of protection equivalent to, or better than, that intended by the provincial framework must be achieved with a proposed regional framework.

Table 1 **Comparison of Acid Deposition Management Framework Elements that may vary between the Provincial Acid Deposition Management Framework and Possible Regional/Airshed Acid Deposition Management Frameworks and the Implications and Requirements Related to these Differences**

Framework Element	Provincial Framework	Possible Regional Framework	Implication	Regional Framework Requirement
Acidifying Emissions	When calculating the acid loading, the framework assumes that the acid inputs for a given evaluation year occur at that rate at a constant and sustained rate (i.e. is a steady state acid input)	Acid inputs could be calculated considering short and long-term emission trends and varying (i.e. dynamic) acid inputs over time	Acceptable acid loadings in regional frameworks at times could be higher than those in the provincial framework because the temporal variation in emissions is considered	The long term level of protection provided by regional frameworks must be equivalent to that provided by the provincial framework and acid inputs cannot result in adverse impacts to greater than 5% of the management area
Modeled Potential Acid Inputs	Uses the RELAD model to translate emission values/estimates into predicted acid deposition on a 1° by 1° grid cell	May use other models e.g. CALPUFF or CMAQ, to translate emission values/estimates into predicted acid deposition	Acid deposition estimates used in regional frameworks may be higher or lower than those calculated under the provincial framework due to model parameterization and scale differences	Significant differences between regional and provincial framework acid deposition estimates for an area must be rationalized and if regional estimates are lower and are used then their use must be justified
Modeled Impacts of Potential Acid Inputs	Uses a steady state mass balance approach (with some general assumptions on the environmental behavior of deposited acid species) to predict potential exceedances of allowable loads	May use dynamic models that reflect the dynamic and varying behavior of deposited acid species in ecosystems to predict impacts and/or set allowable loads	The amount of deposition that is acidifying may be less than in the provincial framework (which is conservative because it assumes that all nitrogen deposition is acidifying) and allowable loadings in the	Dynamic models should be reflective of the ecosystems being managed and validated/updated on a regular basis with the long term level of protection provided equivalent to, or better than, that provided

Framework Element	Provincial Framework	Possible Regional Framework	Implication	Regional Framework Requirement
			short term may be higher than provincial levels	under the provincial model
Spatial scale	Uses a 1° by 1° grid cell as a management unit	May use a different spatial scale for establishing management areas	Could result in the provincial 95% protection criteria being met in a grid cell but in the same grid cell the regional framework may not be met	The 95% level of protection criteria must be met as a minimum on whatever spatial scale is used regionally
Ecosystem sensitivity	Uses broad scale maps of soil sensitivity and soil ability to reduce acid to establish soil and water critical loads for each 1° by 1° grid cell	May use finer scale and/or more detailed soils and water quality information, and specific ecosystem or species effects information to set critical loads	The long term critical loads for an area may be different from those in the provincial framework based on more detailed regional information and consideration of other effects e.g. direct effects on vegetation	Regional sensitivity mapping should be scientifically defensible and any significant differences with the provincial sensitivity mapping justified
Use of monitoring data	Establishes a monitoring load, which if through modeling is triggered in a grid cell, leads to additional monitoring and research in the cell for the purpose of checking the model predictions and determining if actions need to be started to reduce deposition	May use monitoring data instead of, or in. conjunction with, model outputs to establish acid inputs and to determine if regional acid deposition management frameworks are being met	Monitored loads may be significantly different than modeled loads and therefore the provincial framework may predict loads either higher or lower than those measured and used in a regional framework	The use of monitored loads instead of modeled loads must consider if the monitored loads are representative, on a regional basis, of the monitoring network and the reliability of the monitoring results

6.0 REFERENCES

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